Remarks

The Applicants have amended claims 1, 7, 11, 17, 21, 27, 32, 41, 51, 53 and 55 for clarity. Claim 35 has been rewritten as an independent claim to put claims 35-40 in a form that the Examiner deemed allowable.

As noted at page 1, lines 12-30 of the Applicants' specification, most large businesses operate LANs at several sites and interconnect these LANs using dedicated circuits leased from Network Service Providers. As explained in the Applicants' specification, the leased dedicated circuits are sized to meet the maximum bandwidth requirements of the interconnections and frequently operate below capacity making inefficient use of the Network Service Provider network.

Many of the LANs operated by large businesses operate according to IEEE 802.1 standards. These standards provide protocols, among them 802.1q, that enable the businesses to partition their LANs into multiple Virtual LANS (VLANs). So, for example, a large business may partition its LANs into separate VLANs for different departments or operations of the business, like Finance, Manufacturing, Design and Legal.

The Applicants' networks, routing devices and packet routing methods go beyond the VLAN capabilities required by IEEE 802.1q to enable Network Service Providers to provide interconnection between LAN segments. This enables interconnection of a very large number of VLANs on shared Service Provider network facilities in a manner which makes more efficient use of the Service Provider network than the typical leased dedicated circuits, while preserving isolation between the data communications of separate customers, and while preserving the VLAN partitioning of those customers within their own data networks. Such shared Service Provider network facilities can comprise data switches or routing devices at multiple nodes distributed across one or more extended metropolitan areas, and transmission facilities linking the data switches or routing devices as shown, for example, in Figure 1 of the Applicants' specification.

As noted at page 1, line 31 to page 2, line 11 of the Applicants' specification, the 12 bit capacity of the VLAN tag specified by the IEEE 802.1q standard limits the number of distinct VLANs to 4095. Network Service Providers need to support many more than 4095 distinct customers on a shared network. Moreover, many customers of the Network

Service Providers are already using the IEEE 802.1q VLAN identifier to partition their own networks and do not want Network Service Providers to disrupt such partitioning by changing the VLAN identifiers on packets traversing the Service Provider networks or by restricting their use of particular VLAN identifiers. The Applicants' invention does not rely on IEEE 802.1q VLAN identifiers to isolate VLAN from VLAN and customer from customer. Consequently, the Applicants' invention is not limited by the restricted size of the IEEE 802.1q VLAN identifier space, and permits each customer to assign VLAN identifiers without considering how other customers may be assigning VLAN identifiers.

The Applicants claim communications networks, routing devices for such communications networks and methods of routing packets through such communications networks in which each packet entering a network at an ingress virtual port is assigned a respective *egress address* and routed through the communications network according to that respective egress address. The assigned egress address corresponds to a respective destination address of the entering packet when a correspondence between the destination address and an egress address is known. When no correspondence between the destination address and an egress address is known, the assigned address is a *broadcast egress address* which is *selected based on the ingress virtual port* to correspond to a distinct set of virtual ports, the distinct set of virtual ports comprising the ingress virtual port. Consequently, any broadcasting of the entering packet is restricted to the distinct set of virtual ports that includes the ingress virtual port.

The claimed networks, routing devices and packet routing methods enable the Applicants to interconnect large numbers of customer LAN segments for large numbers of different customers without relying on VLAN identifiers to isolate the VLANs and the customers from one another. Because the VLAN identifiers are not relied upon for routing of the packets, the number of customer VLANs that the Applicants can interconnect is not limited by the restricted number of valid IEEE 802.1 VLAN identifiers, and the VLANs and customers are isolated even if different customers use the same VLAN identifiers in their LAN segments.

The Examiner rejected claims 1-7, 9-17, 19-26, 29-30 and 45-56 under 35 USC 103(a) as being unpatentable over Belser (US 6,151,324) in view of Stone (US 6,041,057).

In the Applicants' claims 1-34 and 41-56, an *"egress address"* is assigned to each packet entering a *connectionless* network via an ingress virtual port. The

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egress address corresponds to a respective destination address of the entering packet when a correspondence between the destination address and an egress address is known. The egress address is a *broadcast egress address selected based on the ingress virtual port* to correspond to a unique set of virtual ports to which the ingress virtual port belongs when no correspondence between the destination address and an egress address is known. The assigned egress address is added to the packet, and the packet is routed across the network according to the egress address to the egress virtual port *without establishing a connection across the network for routing the packet.* The egress address is removed from the packet at the egress port.

Belser discloses VLANs connected across a *connection-oriented* network in which *virtual paths* are established so that groups of packets having the same source end station and destination end station are routed according to a *virtual path ID* along the same path through the network. Belser states at column 2, lines 2-4 that *"This is distinguished from connectionless communications, wherein each frame of data is transmitted node-by-node independently of the previous frame."* Belser states at column 4, lines 3-5 that virtual paths must be defined before connections can be made to enable routing of packets across his network. The definition of the virtual paths is an involved process described at column 7, line 6 to column 10, line 11. According to column 5, lines 9-13, Belser routes packets along *established connections* using *virtual path IDs corresponding to the established connections* and not according to assigned *egress addresses.*

Clearly, Belser requires a great deal of overhead processing to establish and manage a large number of virtual paths and virtual circuits. This would be particularly true in one intended application of the Applicants' invention in which a Service Provider network would be required to provide secure connections for a very large number of multi-location customers, each customer potentially having multiple VLANs, each of which could require multiple virtual paths and virtual circuits. In contrast, the Applicants avoid the overhead processing required to establish virtual paths and virtual circuits by routing packets across a *connectionless* network according to assigned *egress addresses.*

Moreover, Belser *relies on VLAN identifiers* defined in the interconnected LAN segments to determine the routing of packets in his interconnecting network. This is clear from column 5, line 59 to column to column 6, line 57 which describe a

discovery operation whereby each edge switch of Belser's network discovers VLAN identifiers for end stations in LAN segments connected to that switch. The VLAN identifiers are stored in local directories at the edge switches and are used by a "VLAN policy" to restrict the flooding of connection requests when a new virtual circuit is required to serve a particular DA/SA combination. Because different customers could use the same VLAN identifiers, Belser would not provide the customer isolation required in a Service Provider network application. Even if Belser were to require that different customers use different VLAN identifiers to preserve customer isolation, a requirement that would not be acceptable to many customers, Belser's network could still only support 4095 distinct VLANs. This limitation would not meet the needs of many Service Provider network applications. The Applicants overcome these limitations by *not* relying on IEEE 802.1 VLAN identifiers set by Service Provider customers in their customer networks.

The Examiner admits that Belser fails to teach the use of a broadcast egress address to route packets when no correspondence between the destination address and an egress address is known. However, the Examiner states that Stone teaches the mapping of unknown destination addresses to broadcast VLAN addresses and argues that it would be obvious to combine the teachings of Belser and Stone to arrive at the Applicants' claims.

Stone discloses VLANs interconnected across an ATM network using ATM tag switching. Because the ATM network is *connection-oriented*, Stone requires a protocol whereby edge switches of the ATM network initiate tagged point-to-point and point-to-multipoint virtual connections for forwarding end-user messages between VLAN segments across the ATM network (column 2, line 38 to column 3, line 43).

The ATM switches forward the end-user messages by associating VLAN identifiers in the end-user messages with tag values of the established tagged virtual connections. The tag values are used to route the end-user messages link by link via the tagged virtual connections. At each successive switch in the tagged virtual connections, the tag values are translated into tag values for a next link of the virtual connection until the end-user messages reach destination edge switches of the ATM network (column 2, line 44 to column 3, line 10).

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VLAN packets comprising the end-user messages are segmented into fixed length ATM cells at the edge switch where they enter the ATM network (column 12, lines 49-51), and must be reconstructed at the edge switch where they leave the ATM network.

Consequently Stone is like Belser, and unlike the Applicants' claims, in teaching a *connection-oriented* network in which packets are routed through the network according to *identifiers associated with pre-established connections* unlike the Applicants' *assigned egress addresses*. Like Belser, and unlike the Applicants' claims, Stone requires considerable overhead to set up and maintain a large number of *connections* through the network. Therefore, any combination taught or suggested by Belser and Stone must also be a *connection-oriented* network in which packets are routed according to *identifiers associated with the pre-established connections* unlike the Applicants' *assigned egress addresses*, and must also require considerable overhead to set up and maintain the large number of connections through the network.

In fact, Stone requires even more additional processing than Belser because, unlike the Applicants' *assigned egress addresses*, the *ATM tags* used by Stone to route packets through his *connection-oriented network* simply provide the routing to the next switch in the ATM network and are changed at each transit switch – i.e. the ATM tags of Stone do not point to the egress point of the network at which the packet leaves the network and are not *"egress addresses"*. The Applicants *"egress addresses"* can be used to route packets at multiple nodes across the network without translation because they identify one or more egress ports of the network. Consequently, the Applicants' claimed approach is very different in practical terms from the Stone's disclosure because Stone requires a significantly more processing at transit nodes to carry a packet across the ATM network than does the Applicants' claimed invention to carry the packet across Applicants' network. Moreover, Stone incurs further processing overhead by breaking incoming LAN frames into ATM cells of standard length (column 12, lines 49-51), and by therefore needing to reconstruct the LAN frames at the egress nodes where the end-user messages are transferred to other VLAN segments.

Moreover, like Belser and unlike the Applicants' claims, Stone *relies on VLAN identifiers* to define VLAN membership and to isolate VLANs. Column 5, lines 32-34 state that Stone's switches share VLAN identifiers in topology advertising messages.

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Column 5, lines 56-61 and column 6, lines 19-21 state that Stone's switches learn VLAN membership from the advertised VLAN identifiers. Column 6, lines 38-53 describe the set-up of point-to-multipoint tagged virtual connections for each VLAN based on the learned VLAN membership. Column 12, lines 26-48 describe use of the point-to-multipoint tagged virtual connections to route "unknown *unicast end-user* messages" within a particular VLAN. Consequently, the point-to-multipoint routing of "unknown unicast messages" depends on VLAN membership *determined from VLAN identifiers*. Because different customers could use the same VLAN identifiers, Stone (like Belser) would not provide the customer isolation required in a Service Provider network application. Even if Stone were to require that different customers use different VLAN identifiers to preserve customer isolation, a requirement that would not be acceptable to many customers, Stone's network (like Belser's) could still only support 4095 distinct VLANs. This limitation would not meet the needs of many Service Provider network applications. The Applicants overcome these limitations by *not* relying on IEEE 802.1 VLAN identifiers set by Service Provider customers in their customer networks.

Furthermore, there is no teaching or suggestion in either Belser or Stone that would motivate a skilled reader to combine these references, and the Examiner has arrived at the particular hypothetical combination advanced in his arguments based only on the hindsight afforded by the Applicants' specification.

In summary, there is no motivation to combine Belser and Stone in the manner suggested by the Examiner, and any such combination would necessarily result in a *connection-oriented* network in which packets are routed according to *identifiers of pre-established connections* which would require considerably more overhead processing to set up and maintain the pre-established connections than the Applicants' *connectionless* network which routes packets according to *assigned egress addresses* and does not require the processing overhead needed for pre-establishment and management of connections through the network. Moreover, any such combination would *rely on VLAN identifiers* to isolate different VLANs, a strategy which does not provide reliable isolation between customers when VLANs of multiple customers are interconnected without restricting the customers' use of the VLAN identifiers. The Applicants' reliance on distinct sets of virtual ports to achieve isolation between VLANs and customers avoids this problem. Applicants therefore submit that amended claims 1-7, 9-17, 19-26, 29-30 and 45-56 are patentable over Belser and Stone, and request reconsideration and allowance of these claims.

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The Examiner rejected claims 7, 27, 32-34, 41 and 44 under 35 USC 103(a) as being unpatentable over Belser (US 6,151,324) in view of Stone (US 6,041,057) and Ross (US 5,394,402). The Examiner admitted that neither Belser nor Stone disclose encapsulation of address information in a packet, and cited Ross to show such encapsulation.

There is no teaching or suggestion in any of Belser , Stone or Ross that would motivate a skilled reader to combine these references, and the Examiner has arrived at the particular hypothetical combination advanced in his arguments based only on the hindsight afforded by the Applicants' specification.

Moreover, applying the encapsulation of Ross to the Examiner's hypothetical combination of Belser and Stone would merely result in encapsulation of Belser's *virtual path identifier* or Stone's *ATM connection tag* in packets to be routed through a *connection-oriented* network. Such a combination would still result in a *connection-oriented* network in which packets are routed according to *identifiers of pre-established connections* which would require considerably more overhead processing to set up and maintain the pre-established connections than the Applicants' *connectionless* network which routes packets according to *assigned egress addresses* and does not require the processing overhead needed for pre-establishment and management of connections through the network.

Moreover, like both Belser and Stone, Ross *relies on VLAN identifiers* for isolation between VLANs (see column 7, line 67 to column 8, line 18). As noted at length above, reliance on VLAN identifiers to isolate different VLANs does not provide reliable isolation between customers when VLANs of multiple customers are interconnected via a common Service Provider network without restricting the customers' use of the VLAN identifiers. The Applicants' reliance on distinct sets of virtual ports to achieve isolation between VLANs and customers avoids this problem.

The Applicants therefore submit that claims 7, 27, 32-34, 41 and 44 are patentable over Belser, Stone and Ross, and request reconsideration and allowance of these claims.

The Applicants acknowledge with thanks the allowance of claims 8, 18, 28 and 31.

The Examiner objected to claims 35-40 and 43 as being dependent on rejected base claims, but stated that these claims would be allowable if rewritten in independent form including all limitations of the base claim and any intervening claim. The Applicants have amended claim 35 accordingly. As claims 36-40 depend from amended claim 35, the Applicants submit that claims 35-40 are now in condition for allowance and request reconsideration and allowance of these claims.

Claim 43 depends from amended claim 41 and is patentable over Belser, Ross and Stone for the reasons advanced above with respect to amended claim 41. The Applicants therefore request reconsideration and allowance of claim 43.

In view of the above amendments and discussion, the Applicants request allowance of the amended application.

Yours very truly,

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